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Analysis of high school students' opinions on the benefits and harms of nuclear energy in terms of environmental values

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Abstract

The aim of this study is to analyze the high school students' opinions on the benefits and harms of nuclear energy in terms of environmental values. This study is a descriptive field research. The study was carried out with the participation of 176 high school students. In order to collect data, an assessment tool which consists of open-ended questions and 3-point Likert type questions was used. The data were analyzed through the content analysis method. After the study, 95.45% of the students expressed that their knowledge levels about nuclear energy were inadequate, and 52.84% of the students considered nuclear energy to be harmful. Moreover, the students match the issue of nuclear power with the issue of nuclear power plants. On the other hand, the students stated that nuclear energy primarily calls radiation and the increase in cancer incidences to mind.

Keywords: Nuclear energy; nuclear power plants; benefits of nuclear energy; harms of nuclear energy; environmental values.

1. Introduction

Today, the population of energy has become an important issue due to several social and economic reasons as well as the increase of the world population. The increased demand for energy has turned into an intensive endeavour to produce energy from fossil fuels. However, as a result of this, along with several undesired natural events such as the greenhouse effect, global climate changes, melting of glaciers and the extinction of species; the possibility of carbon-based reserves to be exhausted in 30-40 years with the current consumption rate urged the humankind to find alternative ways of energy production.

Various debates have taken place and several different opinions have been presented about alternative ways of energy production in the public opinion. Since it is not possible with the current technology to effectively benefit from the energies obtained from natural and renewable energy sources such as solar, wind and tide energies, the attention is concentrated on the issue of nuclear energy. In recent years, several contradicting opinions have emerged; while one side advocates the necessity of closing all nuclear facilities, the other side argues that the

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nuclear technology can be considered among the clean energy sources (Altın and Kaptan, 2006). Throughout the world, the attention of the society and students in the use of nuclear energy, and the media's interest in the accidents happening in nuclear power plants show that the information sources about this issue are not only schools. Family, school, social environment and means of mass communication are of big importance for students to get knowledge of an issue and to develop sense of responsibility.

High amounts of radioactive items were spreaded over an extensive area after the nuclear reactor accident that occurred on 6 April 1986 at the Chernobyl Nuclear Power Plant in Russia. It has been stated that lichens in Apsele region of Sweden and meadow grasses in the Miesbach region of Germany have high amounts of nuclear radiation (Çepel, 2003). This raised concerns about the safety of nuclear power in the world. Some scientists, on the other hand, believe that these concerns are unnecessary. In the literature, no studies have been found that aim to determine the opinions of high school students on this issue. Therefore, it is expected that the results of this study will provide a significant amount of data to the literature.

2. Aim

In this study, the high school students' opinions on the benefits and harms of nuclear energy are analyzed in terms of environmental values. To this end, answers to the following question were sought:

1. What are the high school students' knowledge levels and knowledge sources about nuclear energy?
2. Do high school students consider themselves to be adequate in the issue of nuclear energy?
3. What are the high school students' opinions on the benefits and harms of nuclear energy?

3. Method

This study is a descriptive field research.

3.1. Sample

The study was carried out with the participation of 176 randomly selected students enrolled in an high school in the city center of Ankara in 2008-2009 academic year. 94 (53.40%) of these 176 students were females and 82 (46.60%) of them were males. 130 (73.86%) of these students attend the ninth grade and 46 (26.14%) of them attend the tenth grade. 68 (52.30%) of the ninth grade students were females and 62 (47.70%) of them were males, and 26 (56.52%) of the tenth grade students were females and 20 (43.48%) of them were males.

3.2. Data collection instruments

As the data collection instrument of the study, an assessment tool which consisted of 6 open-ended questions and 3-point Likert type questions was used. The relevant literature and expert opinions were used in the preparation of the data collection instrument.

3.3. Data analysis

The collected data were analyzed through the content analysis method, and presented as tables and graphs by using frequency and percentage values. The SPSS 15 software was used in the analysis of the data.

4. Results (Findings)

1. The findings related to the question “What are the high school students' knowledge levels and knowledge sources about nuclear energy?” are presented in Table 1 and Figure 1.

Table 1. The distribution of the students' opinions on the question “What do you think nuclear energy is?”

		9th Grade			10th Grade		Total	
What is Nuclear energy?	**Gender**	**frequency**	**%**	**Gender**	**frequency**	**%**	**frequency**	**%**
1.I don't know.	Female	33	25.3	Female	10	21.7	43	45.7
	Male	37	28.4	Male	7	15.2	44	53.6

		Total	70	53.7	Total	17	36.9	87	49.4
	a. Is a sort of energy composed of atoms?	Female	1	0.76	Female	6	13	7	7.2
		Male	1	0.76	Male	6	13	7	8.5
		Total	2	1.5	Total	12	26	14	7.9
	b. Is a sort of energy related to radiations?	Female	3	2.3	Female	7	15.2	10	10.6
		Male	0	0	Male	2	4.3	2	2.4
		Total	3	2.3	Total	9	19.5	12	6.8
2. Is a sort of energy. (24.3%)	c. Is a sort of chemical energy?	Female	0	0	Female	0	0	0	0
		Male	4	3	Male	1	2.1	5	6
		Total	4	3	Total	1	2.1	5	3.4
	d. Is a sort of energy obtained from renewable sources?	Female	4	3	Female	0	0	4	4.2
		Male	7	5.3	Male	0	0	7	8.5
		Total	11	8.4	Total	0	0	11	6.2
	a. Electrical energy is produced from it.	Female	9	6.9	Female	1	2.1	10	10.6
		Male	2	1.5	Male	1	2.1	3	3.6
		Total	11	8.4	Total	2	4.2	13	7.3
	b. It is used in defense industry.	Female	0	0	Female	0	0	0	0
3. Beneficial to human beings and to the environment. (20.9%)		Male	5	3.8	Male	0	0	5	6
		Total	5	3.8	Total	0	0	5	3.4
	c. Provides energy.	Female	7	5.3	Female	6	13	13	13.8
		Male	0	0	Male	5	10.8	5	6
		Total	7	5.3	Total	11	23.8	18	10.2
	a. Harmful to the environment and nature.	Female	1	0.76	Female	3	6.5	4	4.2
		Male	3	2.3	Male	1	2.1	4	4.8
		Total	4	3	Total	4	8.6	8	4.5
4. Harmful to human beings and to the environment. (7.3%)	b. Harmful to human health.	Female	1	0.76	Female	2	4.3	3	3.2
		Male	1	0.76	Male	1	2.1	2	2.4
		Total	2	1.5	Total	3	6.5	5	2.8

As seen in Table 1, 49.4% of the students responded that they “don't know” what nuclear energy is. 53.7% of the ninth grade students and 36.9% percent of the tenth grade students responded that they do not know. 45.7% of the female students and 53.6% of the male students expressed that they do not have any idea about the issue. 24.3% of the students stated that nuclear energy is a sort of energy. However, 6.2% of the students expressed that nuclear energy is a renewable source of energy. All of the students who were of this opinion were ninth grade students. While 20.9% of the students defined nuclear energy as a beneficial sort of energy, 7.3% of them considered nuclear energy to be a sort of energy which is “harmful to human beings and to the environment”. The following data have been obtained from the students' responses to the question “How have you obtained your knowledge about nuclear energy?”; the students juxtaposed their knowledge sources as 34.1% television, 25.1% school and course books, 18.2% internet, 15.2% newspapers and journals, and 7.4% other sources of information.

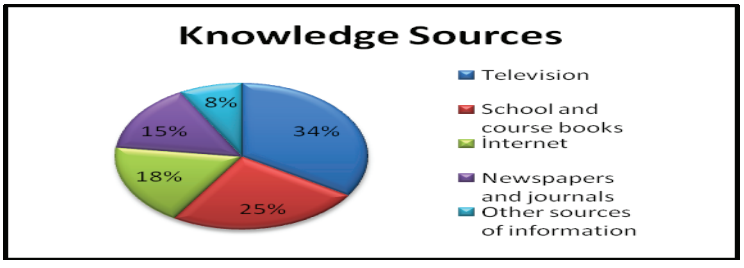

Figure 1. The distribution of the students' opinions related to their knowledge sources

2. The findings related to the question “Do high school students consider themselves to be adequate in the issue of nuclear energy?” are presented in Table 2 and Figure 2.

Table 2. The distribution of the students' opinions on the question “Do you think that you have adequate knowledge about nuclear energy?”

Do you think that you have adequate knowledge about nuclear energy?	9th Grade			10th Grade			Total	
	Gender	frequency	%	Gender	frequency	%	frequency	%
Yes	Female	5	3.8	Female	1	2.1	6	6.3

	Male	0	0	Male	2	4.3	2	2.4
	Total	5	3.8	Total	3	6.5	8	4.5
	Female	56	43	Female	25	54.3	81	86.1
No	Male	58	44.6	Male	18	39.1	76	92.6
	Total	114	87.6	Total	43	9.4	157	89.2
	Female	7	5.3	Female	0	0	7	7.4
No comment	Male	4	3	Male	0	0	4	4.8
	Total	11	8.3	Total	0	0	11	6.2

As seen in Table 2, 4.5% of the students answered “Yes” and 89.2% of them answered “No” to the question “Do you think that you have adequate knowledge about nuclear energy?. 6.2% of the students did not express any comment. All of the students who did not comment on this question were ninth grade students. 3.8% of the ninth grade students and 6.5% of the tenth grade students stated that they have adequate knowledge about nuclear energy. 6.3% of the female students and 2.4% of the male students expressed that they have adequate knowledge about the issue. Therefore, these findings indicate that the students do not have the adequate level of knowledge about the issue.

4. The findings related to the question “What are the high school students' opinions on the benefits and harms of nuclear energy?” are presented in Table 3.

Table 3. The distribution of the students' opinions on the benefits of nuclear energy

Benefits of nuclear energy	9th Grade			10th Grade			Total	
	Gender	frequency	%	Gender	frequency	%	frequency	%
	Female	53	40.7	Female	18	39.1	71	75.5
	Male	44	33.8	Male	8	17.3	52	63.4
1. No idea.	Total	97	74.5	Total	26	56.5	123	69.8
	Female	9	6.9	Female	2	4.3	11	11.7
2. It increases the energy and electricity production.	Male	2	1.5	Male	9	19.5	11	13.4
	Total	11	8.4	Total	11	23.9	22	12.5
	Female	0	0	Female	0	0	0	0
3. It is necessary for the national defense.	Male	1	0.7	Male	1	2.1	2	2.4
	Total	1	0.7	Total	1	2.1	2	1.1
	Female	0	0	Female	2	4.3	2	2.1
4. It terminates the chemicals that are harmful to the	Male	4	3	Male	1	2.1	5	6
environment.	Total	4	3	Total	3	6.4	7	3.9
	Female	6	4.6	Female	4	8.6	10	10.6
5. It has no benefit.	Male	11	8.4	Male	1	2.1	12	14.6
	Total	17	13	Total	5	10.8	22	12.5

As seen in Table 3, 69.8% of the students stated that they have no idea about the benefits of nuclear power. This rate was 74.5% among the ninth grade students and 56.5% among the tenth grade students. 12.5% of the students think that nuclear energy increases the energy and electricity production, 1.1% of them think that it is necessary for the national defense, and 3.9% of them think that it terminates the chemicals that are harmful to the environment. According to these findings, 17.6% of the students expressed that nuclear energy is a beneficial sort of energy. 13.8% of the female students and 21.8% of the male students stated that nuclear energy is beneficial. Thus, it was determined that the percentage of male students who considered nuclear energy to be beneficial is higher than that of female students. Moreover, 12.5% of the students stated that nuclear energy is of no benefit.

Table 4. The distribution of the students' opinions on the harms of nuclear energy

Harms of nuclear energy	9th Grade			10th Grade			Total	
	Gender	frequency	%	Gender	frequency	%	frequency	%
	Female	34	26.1	Female	10	21.7	44	46.8
	Male	35	26.9	Male	6	13	41	50
1. No idea.	Total	69	53	Total	16	34.7	85	48.2
	Female	15	11.5	Female	15	32.6	30	31.9
2. Harmful to the environment.	Male	7	5.3	Male	8	17.3	15	18.2
	Total	22	16.9	Total	23	50	45	25.5

	Female	21	16.1	Female	5	10.8	26	27.6
3. Dangerous for the human health.	Male	12	9.2	Male	7	15.2	19	23.1
	Total	33	25.3	Total	12	26	45	25.5
	Female	1	0.7	Female	3	6.5	4	4.2
4. Causes nuclear explosions.	Male	1	0.7	Male	3	6.5	4	4.8
	Total	2	1.5	Total	6	13	8	4.5
	Female	2	1.5	Female	0	0	2	2.1
5. Has no harm.	Male	2	1.5	Male	0	0	2	2.4
	Total	4	4	Total	0	0	4	2.2

As seen in Table 4, 48.2% of the students stated that they have no idea about the harms of nuclear energy. 53% of the ninth grade students and 34.7% of the tenth grade students expressed that they have no idea. 25.5% of the students stated that nuclear energy is harmful to the environment, 25.5% of them stated that it is dangerous for the human health, and 4.5% of them stated that nuclear energy may cause nuclear explosions. Totally 55.5% of the students expressed that nuclear energy is harmful. 65.9% of the female students and 48.7% of the male students consider nuclear energy to be harmful. On the other hand, 2.2% of the students think that nuclear energy is of no harm. Moreover, students primarily identify the issue of nuclear energy with the concept of nuclear power plants, and thus, they perceive nuclear energy to be harmful. The distribution of their opinions on the harms of nuclear power plants is presented in Table 5.

Table 5. The distribution of the students' opinions on the harms of nuclear power plants in order of importance

Harms of nuclear power plants	**No**		**Partially**		**Yes**		**Mean**	**Order of importance**
	frequency	**%**	**frequency**	**%**	**frequency**	**%**		
Increase of cancer incidences	11	6.2	69	39.0	97	54.6	2.48	2.
Increase of mutations	20	11.3	74	41.8	83	46.9	2.35	3.
Rise of sea levels	79	44.6	52	29.4	46	26.0	1.80	8.
Increase of drought	46	26.0	53	29.9	78	44.1	2.17	6.
Global warming and climate changes	31	17.5	54	30.5	92	52.0	2.34	4.
Extinction of various species	19	10.7	76	42.9	82	46.4	2.35	3.
Disappearance of wetlands	45	25.4	71	40.1	61	34.5	2.08	7.
Contamination of potable waters	26	14.7	62	35.0	89	50.3	2.35	3.
Increase of soil pollution	30	16.9	73	41.2	74	41.8	2.24	5.
Increase of radioactive wastes	5	2.8	41	23.2	131	74.0	2.71	1.

As Table 5 shows, the students consider the increase of radioactive wastes to be the most important harmful effect created by nuclear power plants (x=2.71), and it is followed by the increase of cancer incidences (x=2.48), the increase of mutations (x=2.35), the extinction of various species (x=2.35), the contamination of potable waters (x=2.35), global warming and climate changes (x=2.34), the increase of soil pollution (x=2.24), the increase of drought (x=2.17) and the rise of sea levels (x=1.80), respectively.

5. Discussion

The issue of nuclear energy is one of the most popular topics in recent years within the context of energy production. Especially the increasing energy need caused by the increasing world population, rising industrialization and the environmental damages caused by fossil fuels called attention to nuclear energy. However, the waste problem of nuclear power plants and their possible negative effects to living beings and to the environment should not be ignored. Individuals should be provided with the correct and scientific information about nuclear energy. It should be noted that the environmental education that students should be provided with will enable them to develop positive attitudes towards the environment (Ekici, 2005; Özdemir et al.. 2004; Uzun and Sağlam 2006; Pekel et al.. 2007; Waters and Powers; 2008).

One of the most important findings of the study was that 49.4% of the participant students stated that they do not have any idea about nuclear energy. The reason of this might be the inadequate coverage of topics related to nuclear energy in the primary and secondary education programs implemented in Turkey. In Özdemir and Çobanoğlu's (2008) study in which they examined the attitudes of teacher candidates towards nuclear energy, 51% of the teacher candidates stated that they do not have any prior knowledge about nuclear power plants. The findings of that study support those of the current study.

When the participant students' knowledge sources are analyzed; they juxtaposed these sources as 34% TV, 25% school and course books, 18% internet, 15% newspapers and magazines and 8% other knowledge sources. According to these findings, students learn about nuclear energy mostly from the means of mass communication. Keay (2001), in his/her study conducted with high school students, determined that the concepts of radiation, radioactivity and the beliefs related to nuclear energy are perceived together and these beliefs and knowledge are obtained from families, friends, and media.

95.4% of the students expressed that they do not have adequate knowledge about nuclear energy. On the other hand, 55.5% of them identified nuclear energy as harmful and 17.6% of them characterized it as a beneficial sort of energy. The reason a high percentage of them characterized nuclear energy as harmful might be lack of knowledge and several reasons such as the Chernobyl accident. Those who considered nuclear energy activities to be necessary put forward several reasons such as defence industry, meeting energy needs and creating new job opportunities. Those students who expressed negative opinions on nuclear energy activities, on the other hand, argued that these activities might affect human health and environment in negative ways.

The first concept that comes to the students' minds about nuclear energy is nuclear power plants. They mentioned, in the order of priority, radioactive wastes and cancer diseases as the harms of nuclear power plants. Boyes and Stanistreet (1994), in their study conducted with 100 students aged between 11 and 16 years in England, found that students have several incorrect knowledge about nuclear energy. 84% of the students expressed that radiation stems from nuclear power plants, and only 33% of them stated that radiation can appear through natural ways and it can come from the space or rocks. 21% of them stated that radiation can be used for beneficial activities such as sterilization, and 78% of them expressed that it has fatal effects such as cancer. Students match nuclear energy, nuclear power plants and radiation with each other and see a cause and effect relationship between them. The findings of this study show high degrees of similarity with those of the study conducted by Boyes and Stanistreet (1994). This can be interpreted in the way that individuals in Turkey and England have common opinions, attitudes, ideas and concerns. Further studies can examine the reasons of this issue.

Moreover, in this study, it was determined that the tenth grade students have more correct knowledge than the ninth grade students do, and the female students consider nuclear energy to be a harmful sort of energy more than the male students do. Özmen and et all (2005) have found that female students' environmental attitudes are higher than those of male students, and argued that female students are more environmentally aware.

6. Conclusion and Recommendations

The following recommendations can be made after the above mentioned conclusions;

1- The number of topics related to nuclear energy can be increased in all levels of education.
2- The number of comprehensive publications can be increased in order to raise consciousness about nuclear energy.
3- Courses related to environmental education and sustainable development can be added to the programs in order for students to learn alternative sources of energy and their possible effects to the environment.

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